Rapid Response Decision Support Tool for Debris-Flow Mitigation

Step 1: Calculate Potential Debris-Flow Volume

Compile input values:

+ Area of slopes > 30% (17˚) = _____ km^2
+ Area of moderately and severely burned slopes = _____ km^2
+ Design Storm Total = _____ mm

+ Based on the values above determine the value for A, B, and C from the graphs.

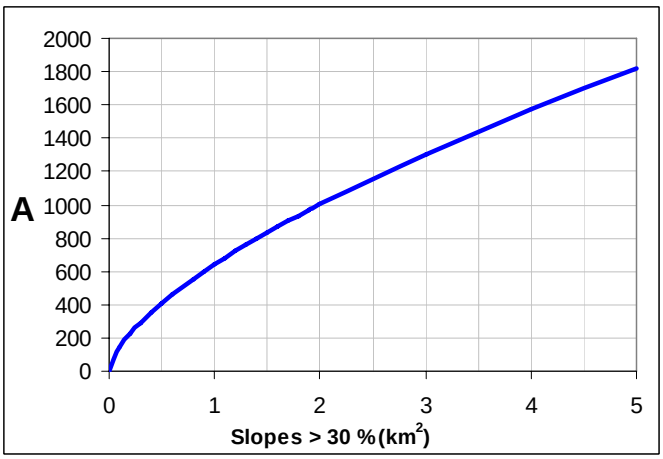
A = _____
B = _____
C = _____

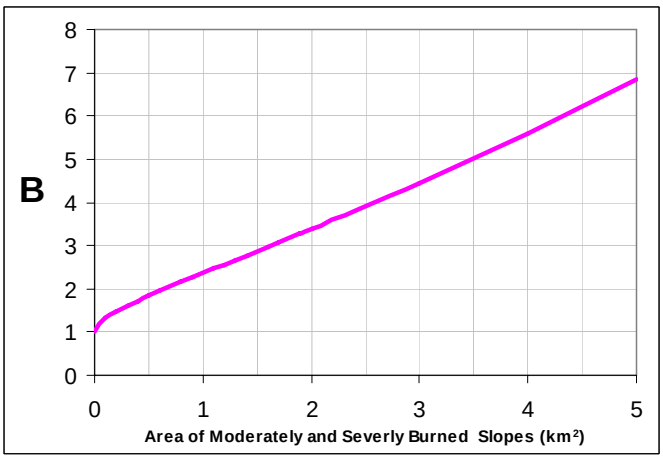
Volume (m^3) = A x B x C

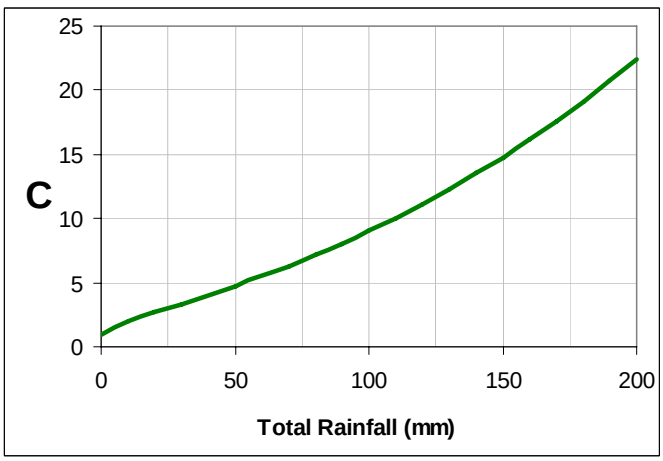
Accurate to within ±30%

Note: Debris flow volumes determined by the Western U.S. Model (Gartner, 2005) with 68% confidence limits. Equation provided below.

$V=EXP(0.65(\ln S)+0.86(B^{1/2})+0.22(R^{1/2})+6.46)$







Step 2: Identify Risk

Basin Risk Level

Critical: Potential to impact vital infrastructure, human life, or create large environmental problems.

Moderate: Significant impact to secondary roads and structures, low risk of loss of life, and minor environmental problems.

Low: Little or no potential to impact life, secondary structures, or environment.

Negligible: Not a consideration.

Step 3: Select Treatment Based on Risk and Cost

Treatment Recommendations Based on Assessed Risk

Critical: Check dams and seeding with mulch, LEBs if feasible.

Moderate: Check dams and anything additional if feasible.

Low: Any combination of treatments as feasible.

Negligible: Monitor, implement recommendations if feasible.

Relative Cost (2005) per acre
< $400
$400 to $800
> $800

Note: Costs are cumulative, and may vary based on site constraints.

Start ⇨ Is the basin < 2km^2? — no → Can structures be relocated and/or debris basins constructed? — yes → See long-term decision tool/relocate; no → Pursue other alternatives

yes → Treatment Options[1]

Check Dams

Do trees 6-12" DIA exist on nearby accessible slopes?

- yes → Construct
- no → Is this area critical?
  - yes → Import materials[3] → Construct
  - no → Apply native plant seed on slopes < 40° at 60 to 75 lb/acre by hand or helicopter

Construct → Check Dams

Properly design and install log-crib or imported material check dams[2]

Regular maintenance. Clear debris accumulated behind check dams

LEBs

Construct → LEBs

LEB Density (/acre)
Critical: 90 to 250
Moderate: 40 to 90
Low: <40

Slope Gradient (%)	Stem Spacing (ft)
>50	10
30-50	15
<30	20

Regular maintenance

post storm event? — no → Regular maintenance

yes → Moderate to High intensity storm?

- no → Clear soil and brush accumulated behind LEBs. Rehabilitate
- yes → Possible LEB failure

Seeding w/ Mulch

Apply native plant seed on slopes < 40° at 60 to 75 lb/acre by hand or helicopter

Mulch

Are the slopes accessible?

- yes → Apply 2.5 tons/acre of mulch by hand and crimp into soil
- no → Apply heli-mulch at a concentration of 2.0 tons/acre

Apply 2.5 tons/acre of mulch by hand and crimp into soil → Are at least of 40% of burned basin slopes < 40˚ treated?

- no → Apply heli-mulch at a concentration of 2.0 tons/acre
- yes → Done

Apply heli-mulch at a concentration of 2.0 tons/acre → If possible, ground crews should break up and spread mulch clumps deposited by helicopter

Footnotes:

[1] Check dams are a channel treatment, whereas LEBs, mulch, and seeding are hillslope treatments. The majority of debris volume is generated from the channel and only about 10 percent from the hillslope.

[2] Check dam failure can amplify debris-flow hazards, so proper design is important. Further information on minimum spacing, geometry, and design references are provided in the supplemental report.

[3] Import of materials may not be possible due to site constraints. Additionally, imported materials will significantly increase the cost.